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Load Ratio and Environmental Effects on Fatigue Crack Growth Rates for Several Ship Steels

S. J. GILL AND T. W. CROOKER

Mechanics of Materials Branch
Material Science and Technology Division

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Fatigue crack growth rate tests were conducted on HY-100, high tensile steel (HS) and medium carbon ship steels. Tests were conducted in air at 5 Hz and in 3.5 percent NaCl salt water under freely corroding conditions at 0.5 Hz. Load ratios of 0.10, 0.67 and 0.80 were investigated in both environments. For data gathered in air, crack growth rates (da/dN) were insensitive to stress ratio and the data conformed to a Paris power law relationship between da/dN and stress-intensity range (ΔK). Salt water exerted a minor effect on da/dN in the HS and medium carbon steels. However, in the higher strength HY-100, a combination of salt water and high load ratios accelerated crack growth rates by approximately a factor of five.

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INTRODUCTION

Medium carbon steel (OS), high tensile steel (HS) and HY-100 steel are being considered as materials for new applications in naval structures. Data on fatigue crack growth rates in air and in salt water are required to aid the design of structures using these materials. To fulfill this need, tests were conducted to determine the fatigue crack growth rates for base material of these alloys in both environments and over a range of cyclic and mean loads.

BACKGROUND

Several surveys of fatigue crack growth rate data for steels have shown that, in the absence of load ratio and environmental effects, crack growth rates above the near-threshold region tend to converge and are very similar for many steels [1, 2]. This study was undertaken, in part, to examine load ratio and salt water environment effects, and in particular the combined effects of load ratio and environment, on fatigue crack growth rates in several medium to high-strength ship steels.

Load ratio (also known as stress ratio or R-ratio where R = minimum load/maximum load) can have varying effects on fatigue crack growth rates in steels. In an air environment, load ratio effects in steels depend upon yield strength and fracture toughness [3-5]. Typically, low to medium-strength steels, such as ship steels, exhibit little or no load ratio effects on fatigue crack growth in air. However, in high-strength steels high load ratios (tension-tension loading) can significantly accelerate crack growth rates. Whether a steel is sensitive to load ratio is primarily dependent on strength/toughness relationships and their effect on the mechanisms of fatigue crack growth.

In lower strength, higher toughness steels fatigue crack growth in air tends to proceed by the ductile striation mechanism, regardless of stress

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ratio. Thus, because the mechanism of crack growth does not change with load ratio, growth rates are also little affected by changes in load ratio. In higher strength, lower toughness steels high load ratios can cause "brittle" mechanisms of crack growth, such as cleavage, to occur resulting in significantly accelerated crack growth rates. However, a similar effect of accelerated crack growth at higher load ratios can occur in lower strength steels if a corrosive environment is present. Several recent studies of structural steels for offshore platform and nuclear pressure vessel applications have revealed significant load ratio effects when a corrosive environment is present [6-8]. This study was undertaken both to contribute to the Navy's data base on fatigue crack growth in ship steels and to examine the interaction of load ratio and salt water environment effects on crack growth behavior in ship steels.

MATERIALS

The materials used in this study included a medium carbon steel (OS) nominally meeting MIL-S-22698A, high tensile steel (HS) nominally meeting MIL-S-16113C and an HY-100 steel meeting MIL-S-16216H. The compositions of these three steels are given in Table 1. Tensile properties are given in Table 2. In each case, the product form was rolled plate. Plate thicknesses were 9.3 mm for the HY-100 and 12.0 mm for the other two steels.

The microstructures of the three steels are shown in Figures 1 through 3. Sections of the longitudinal, transverse and short transverse planes were examined and no significant differences due to orientation were found. The microstructures of both the OS and HS consisted of equiaxed ferrite and pearlite with elongated inclusions. Both were very fine grained, with a grain size corresponding roughly to ASTM grain size number 8 [9]. The HY-100 had a martensitic structure and an ASTM grain size of about 8.

TEST PROCEDURE

Fatigue crack growth rate tests were conducted in ambient room air and in flowing 3.5 percent NaCl solution. Tests in air were conducted in accordance with ASTM E647-81 [10] and tests in salt water were conducted in accordance with a proposed Navy standard test method [11]. A schematic view of the test system is shown in Figure 4.

Wedge-opening-loaded (WOL) specimens with planar dimensions corresponding to the 2T configuration, with width (W) equal to 129.5 mm, were used. Thicknesses (B) were 12.0 mm for the OS and HS specimens and 9.3 mm for the HY-100 specimens. In each case, notches were machined in the T-L orientation, that is, parallel to the final rolling direction of the plate [12]. The test specimen is shown in Figure 5.

Each alloy was tested at three load ratios of $R = 0.1$, 0.67 and 0.8. The cyclic loading frequency for tests conducted in air was 5.0 Hz and for tests conducted in salt water the frequency was 0.5 Hz. For steels of the type studied in this investigation, evidence shows that crack growth rates in air are not affected by cyclic loading frequency [13]. However, for virtually all steels crack growth rates in salt water are frequency dependent.

Generally, crack growth rates in salt water tend to increase with decreasing cyclic frequency [13, 14]. Under freely corroding conditions, a salt water environment has little effect on crack growth rates at frequencies greater than 1 Hz. The frequency of 0.5 Hz used for the salt water tests in this investigation was chosen because it falls within the range of frequencies where environmental sensitivity is known to occur and it approaches loading rates which can occur in surface ship structures.

Crack length measurements were made by means of a crack-opening-displacement (COD) technique [15]. Crack length (a) versus cycles (N) data were reduced to a crack growth rate (da/dN) versus stress-intensity range (ΔK) format by means of a BASIC language computer program on a Tektronix 4051 computer, per ASTM E647-81.

Because of the relatively low yield strengths of the OS and HS materials, and because of the high load ratios included in the test program, special care was taken to assure that minimum remaining elastic ligament criteria for the WOL specimens were not violated per ASTM E647-81. However, because of the low yield strength of the OS material, a slightly less restrictive criterion embodied in the proposed Navy standard was used.

RESULTS AND DISCUSSION

Tabulated values of da/dN and ΔK for each specimen tested are given in Appendix 1. These values are plotted in Figures 6-8. Figures 6 and 7 show that there is little or no effect of load ratio or environment on fatigue crack growth rates in OS or HS. Figure 8 shows that the combination of high load ratio and environment caused approximately a fivefold increase in growth rates in HY-100. Data generated in air tests on HY-100 were compared to data generated during earlier studies [16-18] for two similar steels, HY-80 and HY-130. A plot of all the data for these three steels is shown in Figure 9. The HY-80 data are for an R ratio of zero, while the R ratios for the HY-100 and HY-130 data are 0.1 to 0.67 and 0 to 0.75, respectively.

Crack growth rates for the HY-100 were roughly equivalent to those for HY-80 and slightly lower than those for HY-130. This is because HY-130 exhibits a greater sensitivity to load ratio than does HY-100 and the higher da/dN values for HY-130 in Figure 9 are associated with higher R values in the range of 0.5 to 0.75.

A straight line was fit to all the data which satisfied the appropriate remaining elastic ligament criterion. The form of the equation used to describe these straight lines was the Paris power law [19],

$$\frac{da}{dN} = C(\Delta K)^n.$$

Calculated values of the constants C and n are given in Table 3 where they are compared to trend line values for two broad classes of steels, ferritic-pearlitic and martensitic [1]. Also reported are the correlation coefficients, which quantitatively describe goodness of fit, for each straight line. Fatigue crack growth rate data for OS and HS steel fall below the upper bound postulated by Barsom [1] for ferritic-pearlitic steels in

air. Fatigue crack growth rate data for HY-100 fall below the upper bound postulated by Barsom [1] for martensitic steels in air, except for data obtained at a high load ratio in salt water.

CONCLUSIONS

- For all three steels, da/dN-versus-ΔK data exhibited little or no effect of load ratio in air.
- In medium carbon steel and high tensile steel, salt water under freely corroding conditions caused a minor increase (~2x) in crack growth rates at all load ratios.
- For HY-100 steel, the combination of salt water and a high load ratio ($R = 0.67$ or 0.8) caused a significant (~5x) increase in crack growth rates.
- In most instances, da/dN-versus-ΔK data could be described very well by a Paris power law relationship.
- da/dN-versus-K data for the HY-100 steel in air approximated previous data obtained on HY-80 and HY-130 steels.
- Paris Law constants postulated by Barsom [1] formed an upper bound for these steels in air.

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TABLE 1

Chemical Compositions

Element	Composition[1] (wt. %)					
	Medium Carbon		High Tensile		HY-100	
	sample	specification[2]	sample	specification[3]	sample	specification[4]
Carbon	0.26	-	0.23	0.18 max.	0.13	0.12 - 0.20
Sulfur	0.15	0.05 max.	0.020	0.050 max.	0.013	0.025 max.
Phosphorous	0.010	0.04 max.	0.010	0.040 max.	0.002	0.025 max.
Copper	0.07	-	0.14	0.35 max.	0.07	0.25 max.
Nickel	0.00	-	0.06	0.25 max.	2.33	2.25 - 3.50
Chromium	0.00	-	0.04	0.15 max.	1.24	1.00 - 1.80
Molybdenum	0.01	-	0.03	0.06 max.	0.48	0.20 - 0.60
Vanadium	0.00	-	0.00	0.02 min.	0.00	0.03 max.
Titanium	0.00	-	0.00	0.005 min.	0.00	0.02 max.
Silicon	0.04	-	0.03	0.15 - 0.35	0.22	0.15 - 0.35
Manganese	0.92	-	0.43	1.30 max.	0.22	0.10 - 0.40

[1] Martel Laboratories

[2] MIL-S-22698 A (SHIPS), 8 June 1965, Class A

[3] MIL-S-16113 C (SHIPS), 25 March 1966, Type I

[4] MIL-S-16216 H (SHIPS), 15 March 1972

TABLE 2

Strength of Steels Used

Property	Steel											
	Medium Carbon				High Tensile				HY-100			
	Sample		Specification[1]		Sample		Specification[2]		Sample		Specification[3]	
	MPa	ksi	MPa	ksi	MPa	ksi	MPa	ksi	MPa	ksi	MPa	ksi
0.2% Yield Strength σ_{ys}	276 289	40.1 41.9	221 min.	32 min.	397	57.6	345 min.	50 min.	724 718	105.1 104.2	690 to 827	100 to 120
Tensile Strength σ_{uts}	473 471	68.5 68.4	400 to 490	58 to 71	421 429	61.0 62.2	634 max.	92 max.	800	116.0	N/A	N/A

[1]MIL-S-22698 A (SHIPS), 8 June 1965, Class A

[2]MIL-S-16113 C (SHIPS), 25 March 1966, Type I

[3]MIL-S-16216 H (SHIPS), 15 March 1972

TABLE 3

Calculated Values of Paris Power Law Constants C and n

Environment	Load Ratio	Steel												
		Medium Carbon			High Tensile			Ferrite-Pearlite Steels[1,2]		HY-100			Martensitic Steels[1,2]	
		C $\frac{m/cycle}{(MPa\sqrt{m})^n}$ x10^{-12}	n	Correlation Coeff.	C $\frac{m/cycle}{(MPa\sqrt{m})^n}$ x10^{-12}	n	Correlation Coeff.	C $\frac{m/cycle}{(MPa\sqrt{m})^n}$ x10^{-12}	n	C $\frac{m/cycle}{(MPa\sqrt{m})^n}$ x10^{-12}	n	Correlation Coeff.	C $\frac{m/cycle}{(MPa\sqrt{m})^n}$ x10^{-12}	n
	0.1	.226	3.94	.9992	.373	3.86	.9997	6.89	3	18.6	2.55	.9979	136	2.25
Air	0.67	1.24	3.53	.99[illegible]8	.198	4.17	.9973			4.15	3.08	.9984		
	0.8	1.42	5.28	.9950	.083	4.60	.9604			6.70	2.91	.9861		
3.5	0.1	.401	4.03	.9969	.371	4.03	.9967			292	1.94	.9662		
%	0.67	-	-	-	-	-	-			58.8	2.71	.9950		
NaCl	0.8	251	1.92	.8788	.018	5.40	.9799			4.25	3.61	.9854		

[1] Load ratio = 0.1 to 0.7

[2] Reference [1]

$$C\left(\frac{in./cycle}{(ksi\sqrt{in})^n}\right) = C\left(\frac{m./cycle}{(MPa\sqrt{m})^n}\right) \times \frac{39.37}{(.91)^n}$$

Figure 1 - Microstructure of high tensile steel viewed in short transverse direction

Figure 2 - Microstructue of medium carbon steel viewed in short transverse direction

Figure 3 - Microstructure of HY-100 steel viewed in short transverse direction

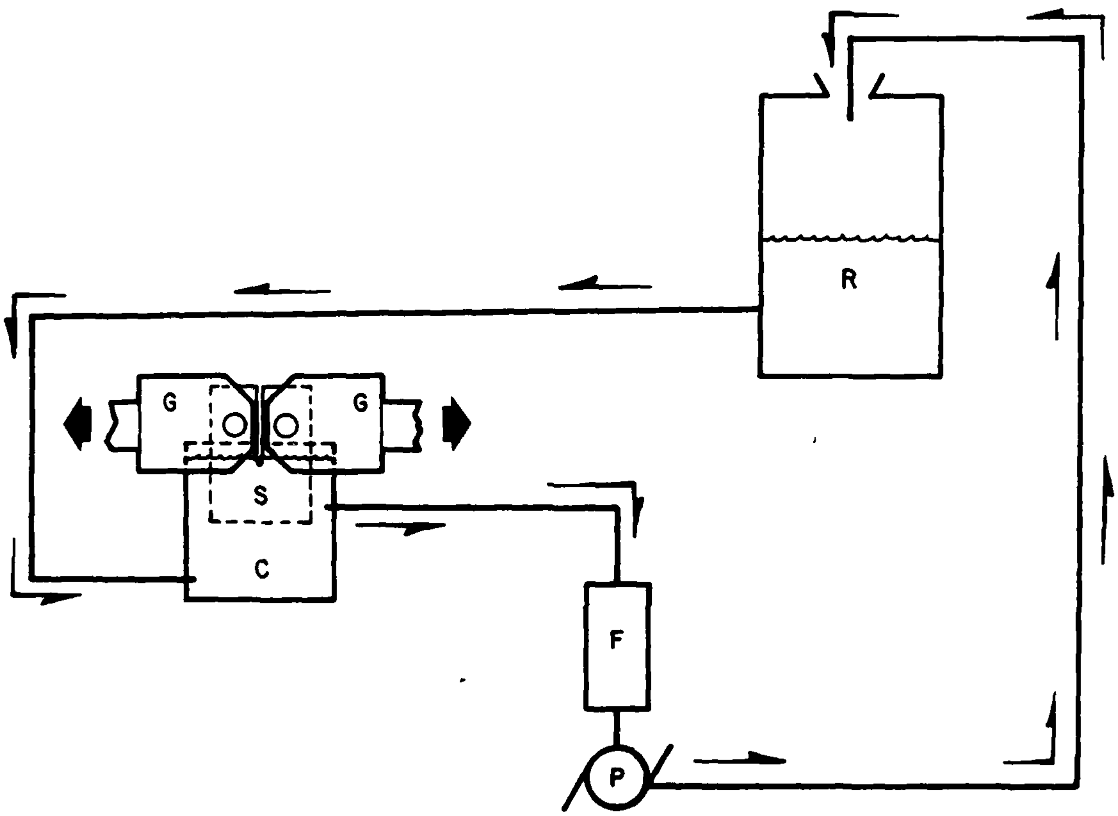
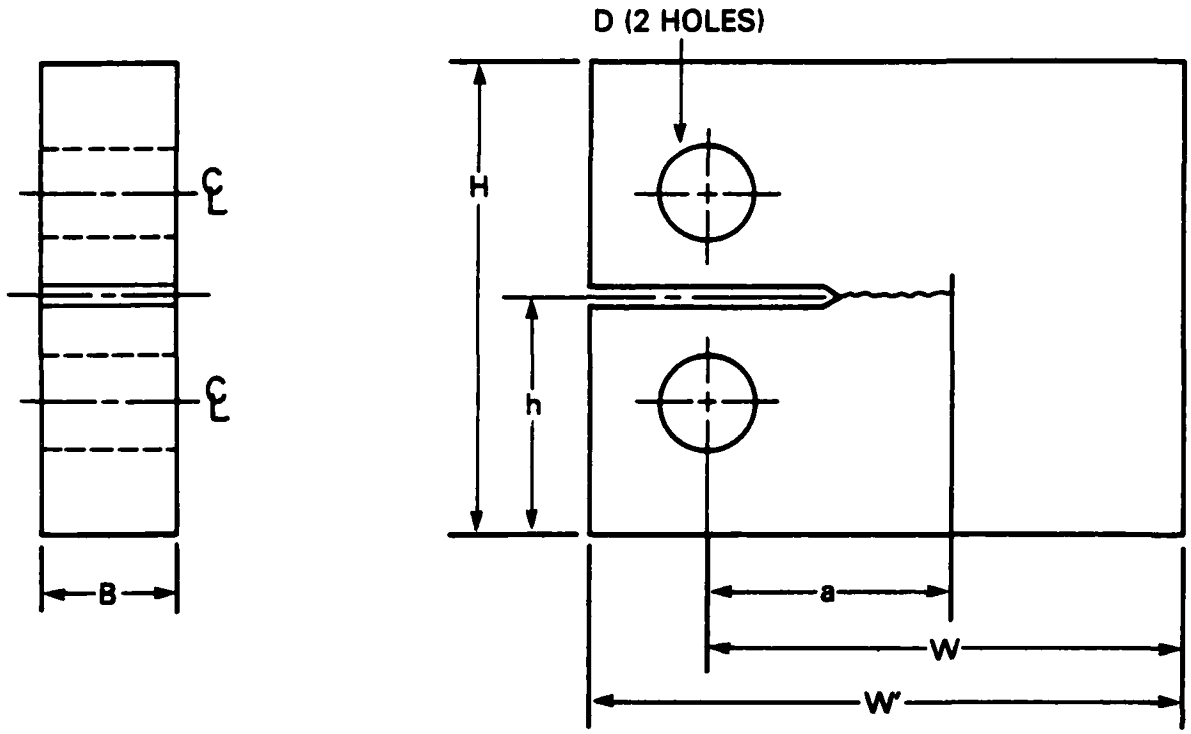


Figure 4 - Environmental circulation system showing the WOL test specimen (S), grips (G), environmental chamber (C), reservoir (R), pump (P), and filter (F)



	inches	mm.
W	5.10	129.54
W'	6.40	162.56
a	variable	variable
h	2.48	62.99
H	4.96	125.98
D	1.00	25.40
B	variable	variable

Figure 5 - 2T wedge-opening-loaded specimen

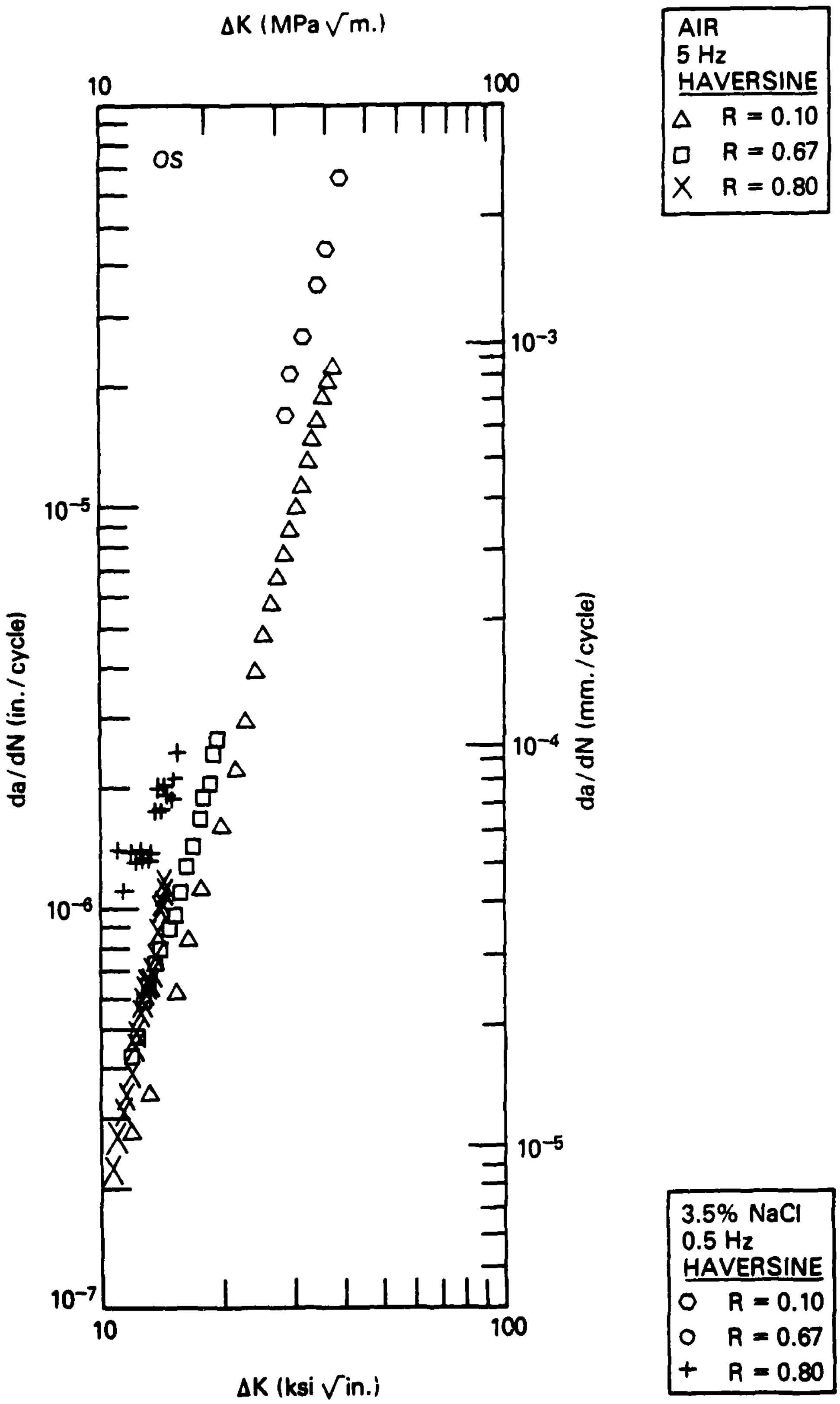


Figure 6 - Fatigue crack growth rate data for medium carbon steel

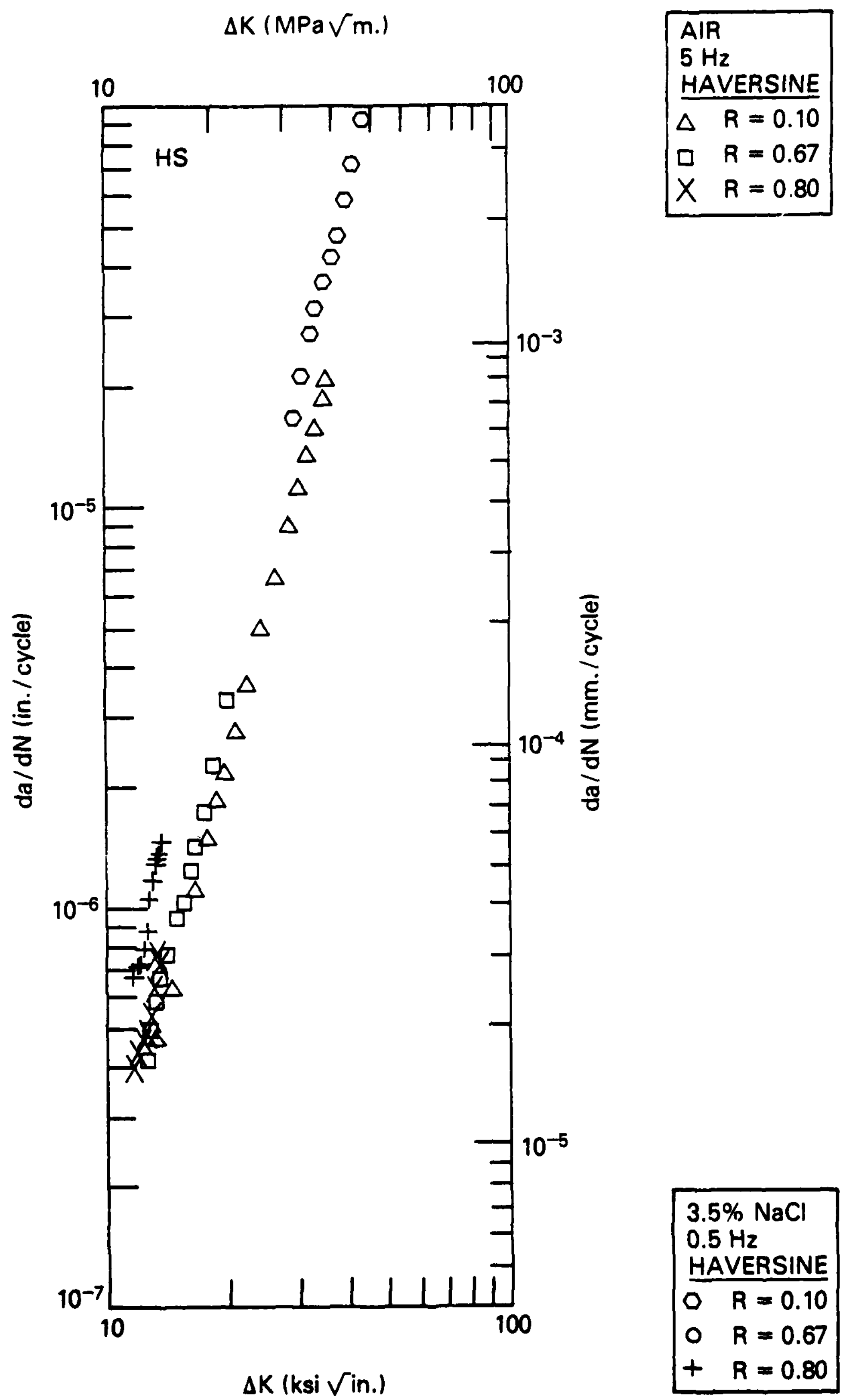


Figure 7 - Fatigue crack growth rate data for high tensile steel

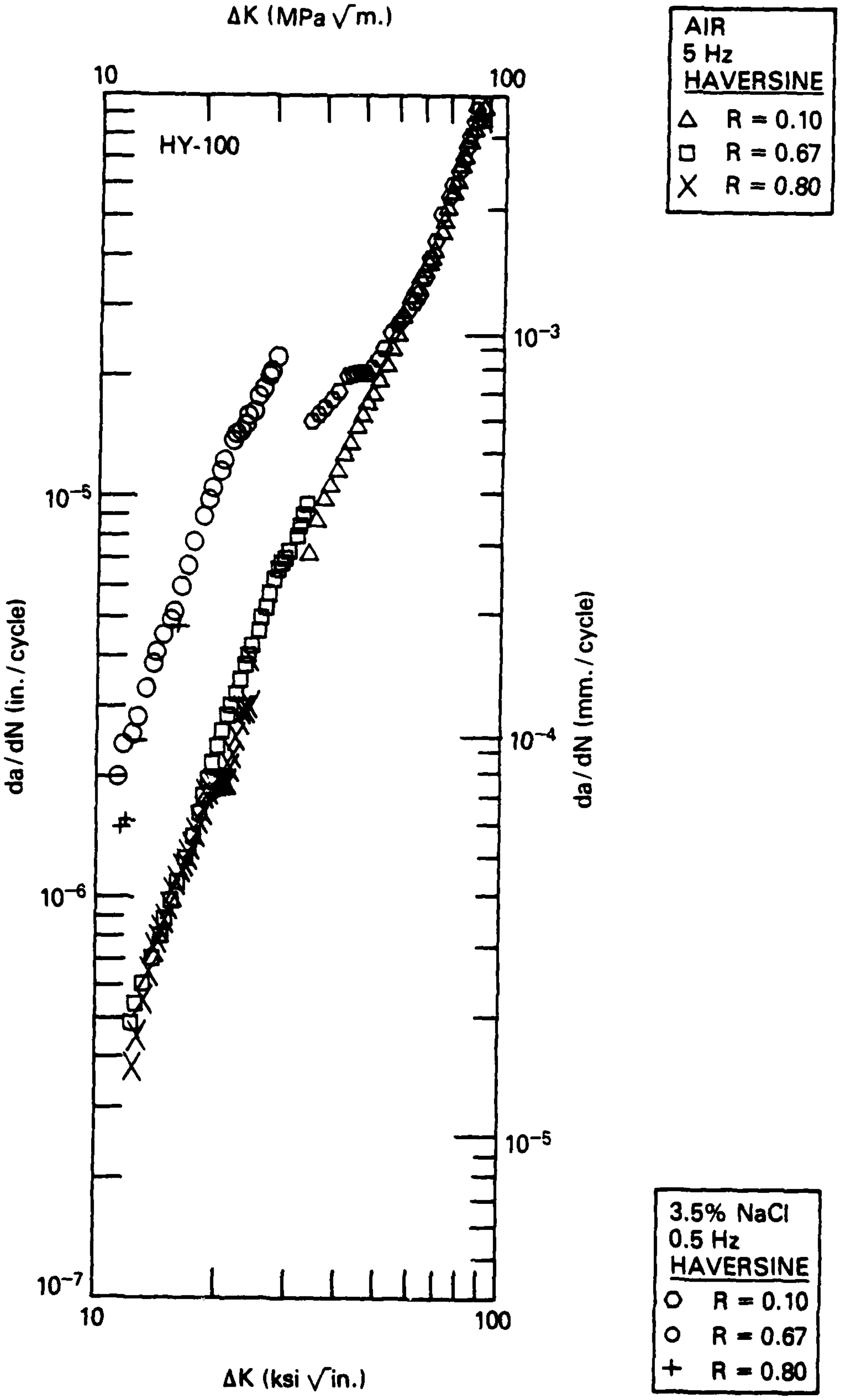


Figure 8 - Fatigue crack growth rate data for HY-100 steel

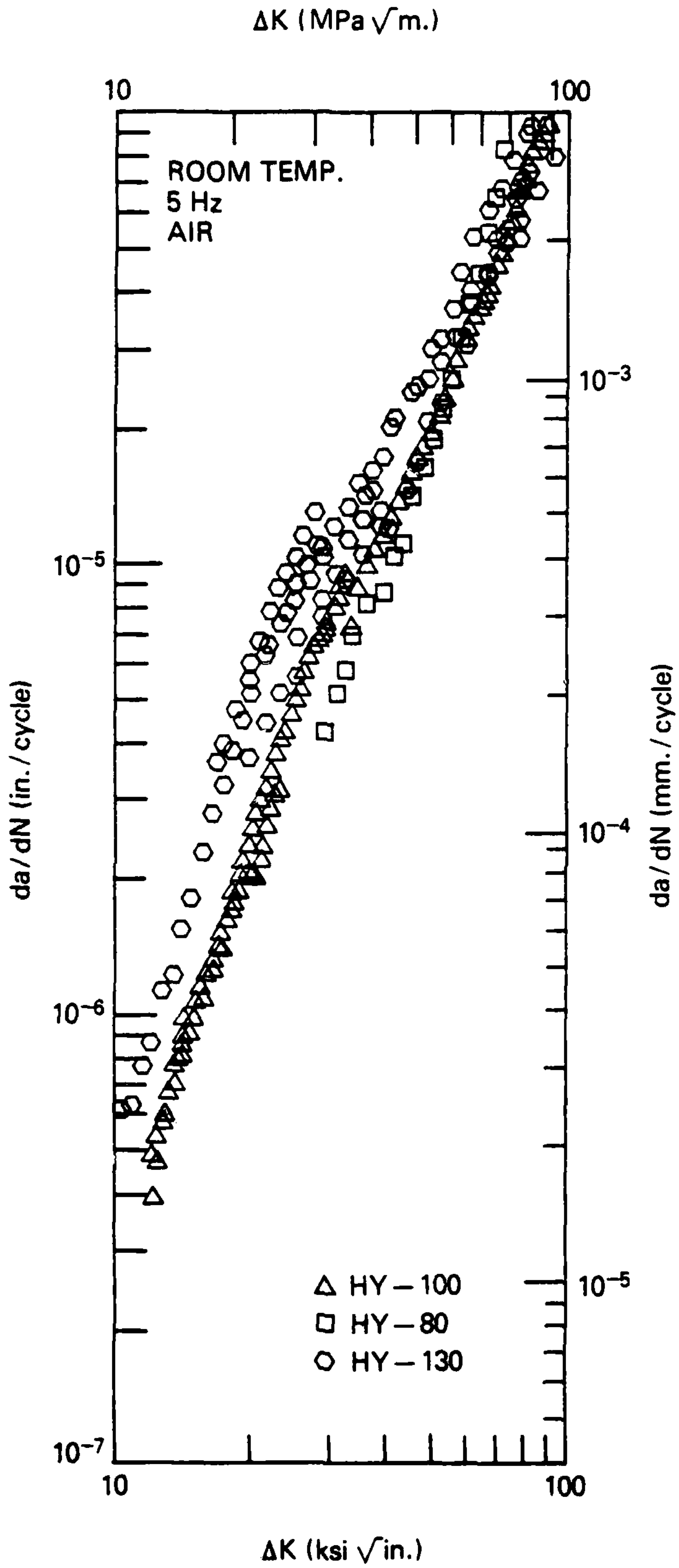


Figure 9 - Fatigue crack growth rate data for HY-80, HY-100 and HY-130 steels

APPENDIX 1

Tabulated Crack Growth Rate Data

MSD C
R- 0.1
TEMP. AMBIENT
FREQUENCY 5 HZ
ENVIRONMENT AIR

7 PT. POLYNOMIAL FIT

(1ST 3 PTS. FIT BY SECANT METHOD)

OBS.	CRACK LENGTH		CYCLES	DA/DN PER CYCLE		DELTA K	
	IN.	MM.		IN.	MM.	KSI $\sqrt{IN.}$	MPA $\sqrt{M.}$
2	1.996	50.7	5240000	2.756E-007	7.001E-006	12.00	13.17
3	2.234	56.8	5950000	3.459E-007	8.786E-006	13.32	14.62
4	2.561	65.1	6300020	6.190E-007	1.572E-005	15.60	17.13
5	2.686	68.2	6500000	8.406E-007	2.135E-005	16.69	18.33
6	2.807	71.3	6650000	1.126E-006	2.859E-005	17.91	19.66
7	2.982	75.8	6795000	1.608E-006	4.085E-005	20.03	21.99
8	3.102	78.8	6865000	2.212E-006	5.618E-005	21.78	23.91
9	3.183	80.9	6900000	2.943E-006	7.476E-005	23.14	25.41
10	3.258	82.7	6925000	3.879E-006	9.853E-005	24.55	26.96
11	3.317	84.2	6940000	4.796E-006	1.218E-004	25.78	28.31
12	3.365	85.5	6950000	5.753E-006	1.461E-004	26.86	29.49
13	3.408	86.6	6957500	6.682E-006	1.697E-004	27.92	30.66
14	3.450	87.6	6963500	7.652E-006	1.944E-004	29.00	31.84
15	3.488	88.6	6968500	8.773E-006	2.228E-004	30.07	33.01
16	3.525	89.5	6972500	9.992E-006	2.538E-004	31.14	34.20
17	3.558	90.4	6975750	1.120E-005	2.844E-004	32.19	35.34
18	3.586	91.1	6978250	1.302E-005	3.308E-004	33.13	36.38
19	3.613	91.8	6980250	1.471E-005	3.736E-004	34.04	37.38
20	3.639	92.4	6982000	1.634E-005	4.150E-004	35.00	38.42
21	3.669	93.2	6983750	1.869E-005	4.748E-004	36.14	39.68
22	3.693	93.8	6985000	2.041E-005	5.185E-004	37.12	40.75
23	3.717	94.4	6986100	2.230E-005	5.664E-004	38.12	41.85

MED C
R= 0.666
TEMP. AMBIENT
FREQUENCY 5 HZ
ENVIRONMENT AIR

7 PT. POLYNOMIAL FIT

OBS.	CRACK LENGTH		CYCLES	DA/DN PER CYCLE		DELTA K	
	IN.	MM.		IN.	MM.	KSI√IN.	MPA√M
4	2.013	51.1	1670000	4.295E-007	1.091E-005	12.01	13.19
5	2.089	53.1	1850000	4.790E-007	1.217E-005	12.41	13.63
6	2.165	55.0	2010000	5.881E-007	1.494E-005	12.83	14.09
7	2.235	56.8	2125000	6.438E-007	1.635E-005	13.24	14.54
8	2.307	58.6	2235000	7.243E-007	1.840E-005	13.69	15.03
9	2.377	60.4	2325000	7.912E-007	2.010E-005	14.15	15.54
10	2.477	62.9	2445000	8.941E-007	2.271E-005	14.86	16.32
11	2.552	64.8	2525000	9.607E-007	2.440E-005	15.44	16.95
12	2.606	66.2	2585000	1.098E-006	2.789E-005	15.89	17.45
13	2.665	67.7	2635000	1.275E-006	3.239E-005	16.41	18.02
14	2.727	69.3	2685000	1.428E-006	3.628E-005	16.99	18.66
15	2.795	71.0	2730000	1.678E-006	4.262E-005	17.69	19.43
16	2.837	72.1	2755000	1.891E-006	4.802E-005	18.15	19.93
17	2.899	73.6	2785000	2.039E-006	5.177E-005	18.87	20.72 *
18	2.928	74.4	2800000	2.415E-006	6.134E-005	19.23	21.11 *
19	2.948	74.9	2810000	2.641E-006	6.707E-005	19.49	21.40 *

*INVALID PER ASTM E-647, PARA. 7.2.1, WHEN YS=41 KSI

MED C
R= 0.666
TEMP. AMBIENT
FREQUENCY 5 HZ
ENVIRONMENT AIR

7 PT. POLYNOMIAL FIT

OBS.	CRACK LENGTH		CYCLES	DA/DN PER CYCLE		DELTA K	
	IN.	MM.		IN.	MM.	$KSI\sqrt{IN.}$	$MPA\sqrt{M.}$
4	2.013	51.1	1670000	4.295E-007	1.091E-005	12.01	13.19
5	2.089	53.1	1850000	4.790E-007	1.217E-005	12.41	13.63
6	2.165	55.0	2010000	5.381E-007	1.494E-005	12.83	14.09
7	2.235	56.8	2125000	6.438E-007	1.635E-005	13.24	14.54
8	2.307	58.6	2235000	7.243E-007	1.840E-005	13.69	15.03
9	2.377	60.4	2325000	7.912E-007	2.010E-005	14.15	15.54
10	2.477	62.9	2445000	8.941E-007	2.271E-005	14.86	16.32
11	2.552	64.8	2525000	9.607E-007	2.440E-005	15.44	16.95
12	2.606	66.2	2585000	1.098E-006	2.789E-005	15.89	17.45
13	2.665	67.7	2635000	1.275E-006	3.239E-005	16.41	18.02
14	2.727	69.3	2685000	1.428E-006	3.623E-005	16.99	18.66
15	2.795	71.0	2730000	1.678E-006	4.262E-005	17.69	19.43
16	2.837	72.1	2755000	1.891E-006	4.802E-005	18.15	19.93
17	2.899	73.6	2785000	2.039E-006	5.179E-005	18.87	20.72
18	2.928	74.4	2800000	2.415E-006	6.134E-005	19.23	21.11
19	2.948	74.9	2810000	2.641E-006	6.709E-005	19.49	21.40

MED C
R= 0.8
TEMP. AMBIENT
FREQUENCY 5 HZ
ENVIRONMENT AIR

7 PT. POLYNOMIAL FIT

(1ST 3 PTS. FIT BY SECANT METHOD)

OBS.	CRACK LENGTH		CYCLES	DA/DN PER CYCLE		DELTA K	
	IN.	MM.		IN.	MM.	KSI$\sqrt{IN.}$	MPA$\sqrt{M.}$
2	1.735	44.1	1075000	2.349E-007	5.966E-006	10.64	11.68
3	1.787	45.4	1275000	2.821E-007	7.164E-006	10.87	11.94
4	1.874	47.6	1469500	3.264E-007	8.292E-006	11.23	12.38
5	1.909	48.5	1575000	3.567E-007	9.059E-006	11.45	12.57
6	1.984	50.4	1775000	4.036E-007	1.025E-005	11.81	12.97
7	2.026	51.5	1875000	4.716E-007	1.198E-005	12.02	13.20
8	2.048	52.0	1925000	5.109E-007	1.298E-005	12.14	13.32
9	2.103	53.4	2025000	5.728E-007	1.455E-005	12.43	13.65
10	2.132	54.1	2075000	6.143E-007	1.560E-005	12.58	13.82 *
11	2.163	54.9	2125000	6.567E-007	1.668E-005	12.76	14.01 *
12	2.200	55.9	2175000	6.794E-007	1.726E-005	12.97	14.24 *
13	2.232	56.7	2225000	6.853E-007	1.741E-005	13.15	14.44 *
14	2.260	57.4	2265000	7.314E-007	1.858E-005	13.32	14.63 *
15	2.298	58.4	2315000	7.970E-007	2.024E-005	13.56	14.88 *
16	2.324	59.0	2350000	9.140E-007	2.322E-005	13.72	15.07 *
17	2.351	59.7	2380000	1.047E-006	2.659E-005	13.90	15.26 *
18	2.380	60.4	2405000	1.088E-006	2.763E-005	14.09	15.47 *
19	2.402	61.0	2425000	1.212E-006	3.078E-005	14.24	15.63 *
20	2.414	61.3	2440000	1.157E-006	2.938E-005	14.32	15.72 *

*INVALID PER ASTM E-647, PARA. 7.2.1, WHEN YS=41 KSI

MED C
R= 0.8
TEMP. AMBIENT
FREQUENCY 5 HZ
ENVIRONMENT AIR

7 PT. POLYNOMIAL FIT

(1ST 3 PTS. FIT BY SECANT METHOD)

OBS.	CRACK LENGTH		CYCLES	DA/DN PER CYCLE		DELTA K	
	IN.	MM.		IN.	MM.	KSI $\sqrt{IN.}$	MPA $\sqrt{M.}$
2	1.735	44.1	1075000	2.349E-007	5.966E-006	10.64	11.68
3	1.787	45.4	1275000	2.821E-007	7.164E-006	10.87	11.94
4	1.874	47.6	1469500	3.264E-007	8.292E-006	11.28	12.38
5	1.909	48.5	1575000	3.567E-007	9.059E-006	11.45	12.57
6	1.984	50.4	1775000	4.036E-007	1.025E-005	11.81	12.97
7	2.026	51.5	1875000	4.716E-007	1.198E-005	12.02	13.20
8	2.048	52.0	1925000	5.109E-007	1.298E-005	12.14	13.32
9	2.103	53.4	2025000	5.728E-007	1.455E-005	12.43	13.65
10	2.132	54.1	2075000	6.143E-007	1.560E-005	12.58	13.82
11	2.163	54.9	2125000	6.567E-007	1.668E-005	12.76	14.01
12	2.200	55.9	2175000	6.794E-007	1.726E-005	12.97	14.24
13	2.232	56.7	2225000	6.853E-007	1.741E-005	13.15	14.44
14	2.260	57.4	2265000	7.314E-007	1.858E-005	13.32	14.63
15	2.298	58.4	2315000	7.970E-007	2.024E-005	13.56	14.88
16	2.324	59.0	2350000	9.140E-007	2.322E-005	13.72	15.07
17	2.351	59.7	2380000	1.047E-006	2.659E-005	13.90	15.26
18	2.380	60.4	2405000	1.088E-006	2.763E-005	14.09	15.47
19	2.402	61.0	2425000	1.212E-006	3.078E-005	14.24	15.63
20	2.414	61.3	2440000	1.157E-006	2.938E-005	14.32	15.72

MED C
R= 0.8
TEMP AMBIENT
FREQUENCY 0.5 HZ
ENVIRONMENT 3.5 % NA L

7 PT. POLYNOMIAL FIT

(1ST 3 PTS. FIT BY SECANT METHOD)

OBS.	CRACK LENGTH IN.	CRACK LENGTH MM.	CYCLES	DA/DN PER CYCLE IN.	DA/DN PER CYCLE MM.	DELTA K $KSI\sqrt{IN.}$	DELTA K $MPA\sqrt{M.}$
2	1.797	45.6	375000	1.455E-006	3.696E-005	10.97	12.04
3	1.881	47.8	470000	1.155E-006	2.932E-005	11.36	12.47
4	1.977	50.2	495000	1.436E-006	3.647E-005	11.83	12.99
5	2.044	51.9	540000	1.369E-006	3.476E-005	12.17	13.36
6	2.089	53.1	570000	1.448E-006	3.679E-005	12.41	13.62
7	2.132	54.2	600000	1.382E-006	3.511E-005	12.64	13.88 *
8	2.210	56.1	655000	1.377E-006	3.498E-005	13.07	14.37 *
9	2.227	56.6	670000	1.430E-006	3.633E-005	13.18	14.48 *
10	2.299	58.4	720000	1.816E-006	4.612E-005	13.63	14.96 *
11	2.334	59.3	740000	2.067E-006	5.250E-005	13.85	15.21 *
12	2.365	60.1	755000	1.830E-006	4.649E-005	14.06	15.44 *
13	2.392	60.8	765000	2.107E-006	5.353E-005	14.24	15.64 *
14	2.430	61.7	785000	1.998E-006	5.074E-005	14.51	15.93 *
15	2.482	63.0	815000	1.953E-006	4.962E-005	14.89	16.35 *
16	2.519	64.0	835000	2.194E-006	5.572E-005	15.17	16.66 *
17	2.539	64.5	845000	2.542E-006	6.456E-005	15.32	16.83 *

*INVALID PER ASTM E-647, PARA. 7.2.1, WHEN YS=41 KSI

MED C
R= 0. 1
TEMP. AMBIENT
FREQUENCY 0. 5 HZ
ENVIRONMENT 3. 5 % NACL

7 PT. POLYNOMIAL FIT

OBS.	CRACK LENGTH		CYCLES	DA/DN PER CYCLE		DELTA K	
	IN.	MM.		IN.	MM.	KSI$\sqrt{IN.}$	MPA$\sqrt{M.}$
7	2. 499	63. 5	2535000	1. 681E-005	4. 269E-004	28. 65	31. 45
8	2. 579	65. 5	2540000	2. 124E-005	5. 394E-004	29. 86	32. 79
9	2. 688	68. 3	2545000	2. 646E-005	6. 720E-004	31. 70	34. 80
10	2. 831	71. 9	2550000	3. 547E-005	9. 009E-004	34. 47	37. 85
11	2. 921	74. 2	2552500	4. 345E-005	1. 104E-003	36. 48	40. 06
12	3. 037	77. 1	2555000	6. 532E-005	1. 659E-003	39. 45	43. 32

MED C
R= 0.8
TEMP. AMBIENT
FREQUENCY 0.5 HZ
ENVIRONMENT 3.5 % NACL

7 PT. POLYNOMIAL FIT

(1ST 3 PTS. FIT BY SECANT METHOD)

OBS.	CRACK LENGTH		CYCLES	DA/DN PER CYCLE		DELTA K	
	IN.	MM.		IN.	MM.	KSI$\sqrt{IN.}$	MPA$\sqrt{M.}$
2	1.797	45.6	375000	1.455E-006	3.696E-005	10.97	12.04
3	1.881	47.8	470000	1.155E-006	2.932E-005	11.36	12.47
4	1.977	50.2	495000	1.436E-006	3.647E-005	11.83	12.99
5	2.044	51.9	540000	1.369E-006	3.476E-005	12.17	13.36
6	2.089	53.1	570000	1.448E-006	3.679E-005	12.41	13.62
7	2.132	54.2	600000	1.382E-006	3.511E-005	12.64	13.83
8	2.210	56.1	655000	1.377E-006	3.498E-005	13.09	14.37
9	2.227	56.6	670000	1.430E-006	3.633E-005	13.18	14.48
10	2.299	58.4	720000	1.816E-006	4.612E-005	13.63	14.96
11	2.334	59.3	740000	2.067E-006	5.250E-005	13.85	15.21
12	2.365	60.1	755000	1.830E-006	4.649E-005	14.06	15.44
13	2.392	60.8	765000	2.107E-006	5.353E-005	14.24	15.64
14	2.430	61.7	785000	1.998E-006	5.074E-005	14.51	15.93
15	2.482	63.0	815000	1.953E-006	4.962E-005	14.89	16.35
16	2.519	64.0	835000	2.194E-006	5.572E-005	15.17	16.66
17	2.539	64.5	845000	2.542E-006	6.456E-005	15.32	16.83

HTS
R= 0.1
TEMP. AMBIENT
FREQUENCY 5 HZ
ENVIRONMENT AIR

7 PT. POLYNOMIAL FIT

(1ST 3 PTS. FIT BY SECANT METHOD)

OBS.	CRACK LENGTH		CYCLES	DA/DN PER CYCLE		DELTA K	
	IN.	MM.		IN.	MM.	KSI$\sqrt{IN.}$	MPA$\sqrt{M.}$
2	1.995	50.7	1527000	4.706E-007	1.195E-005	13.35	14.66
3	2.213	56.2	1900040	6.270E-007	1.593E-005	14.68	16.12
4	2.490	63.3	2040000	1.110E-006	2.820E-005	16.74	18.38
5	2.630	66.8	2160000	1.501E-006	3.812E-005	18.01	19.78
6	2.717	69.0	2220000	1.865E-006	4.737E-005	18.90	20.75
7	2.788	70.8	2260000	2.187E-006	5.554E-005	19.71	21.64
8	2.905	73.8	2310000	2.760E-006	7.010E-005	21.17	23.25
9	3.005	76.3	2346000	3.599E-006	9.142E-005	22.62	24.84
10	3.116	79.1	2376000	4.985E-006	1.266E-004	24.47	26.87
11	3.218	81.7	2396000	6.703E-006	1.702E-004	26.45	29.05
12	3.318	84.3	2410000	8.987E-006	2.283E-004	28.69	31.50
13	3.387	86.0	2417500	1.119E-005	2.841E-004	30.46	33.45
14	3.438	87.3	2422000	1.352E-005	3.435E-004	31.88	35.00
15	3.493	88.7	2426000	1.579E-005	4.010E-004	33.57	36.86
16	3.532	89.7	2428500	1.859E-005	4.722E-004	34.86	38.28
17	3.551	90.2	2430500	2.070E-005	5.258E-004	35.53	39.02

HTS
R= 0.666
TEMP. AMBIENT
FREQUENCY 5 HZ
ENVIRONMENT AIR

7 PT. POLYNOMIAL FIT

OBS.	CRACK LENGTH		CYCLES	DA/DN PER CYCLE		DELTA K	
	IN.	MM.		IN.	MM.	KSI $\sqrt{IN.}$	MPA $\sqrt{M.}$
4	2.135	54.2	2120000	4.139E-007	1.051E-005	12.56	13.79
5	2.191	55.7	2260000	4.948E-007	1.257E-005	12.87	14.13
6	2.250	57.2	2390000	5.828E-007	1.480E-005	13.22	14.51
7	2.320	58.9	2500040	6.648E-007	1.688E-005	13.65	14.99
8	2.397	60.9	2615000	7.578E-007	1.925E-005	14.16	15.54
9	2.502	63.6	2745000	9.391E-007	2.385E-005	14.91	16.37
10	2.592	65.8	2835000	1.028E-006	2.612E-005	15.62	17.15
11	2.660	67.6	2900000	1.227E-006	3.118E-005	16.20	17.79
12	2.706	68.7	2940000	1.410E-006	3.582E-005	16.63	18.26
13	2.793	71.0	3000000	1.732E-006	4.398E-005	17.50	19.21
14	2.881	73.2	3050000	2.258E-006	5.735E-005	18.46	20.27
15	3.010	76.5	3100000	3.284E-006	8.341E-005	20.10	22.06

HTS
R= 0.8
TEMP. AMBIENT
FREQUENCY 5 HZ
ENVIRONMENT AIR

7 PT. POLYNOMIAL FIT

OBS.	CRACK LENGTH		CYCLES	DA/DN PER CYCLE		DELTA K	
	IN.	MM.		IN.	MM.	KSI $\sqrt{IN.}$	MPA $\sqrt{M.}$
4	1.926	48.9	2050000	4.116E-007	1.046E-005	11.50	12.63
5	1.978	50.2	2160000	4.471E-007	1.136E-005	11.76	12.91
6	2.050	52.1	2310000	4.787E-007	1.216E-005	12.12	13.31
7	2.098	53.3	2410000	5.025E-007	1.276E-005	12.38	13.59
8	2.149	54.6	2510000	5.492E-007	1.395E-005	12.65	13.89
9	2.204	56.0	2610000	6.500E-007	1.651E-005	12.97	14.24
10	2.234	56.7	2660000	7.855E-007	1.995E-005	13.14	14.43
11	2.278	57.9	2710000	7.486E-007	1.901E-005	13.41	14.73

HTS
R= 0.1
TEMP. AMBIENT
FREQUENCY 0.5 HZ
ENVIRONMENT 3.5 % NACL

7 PT. POLYNOMIAL FIT

OBS.	CRACK LENGTH		CYCLES	DA/DN PER CYCLE		DELTA K	
	IN.	MM.		IN.	MM.	KSI $\sqrt{IN.}$	MPA $\sqrt{M.}$
6	2.327	59.1	2425000	1.669E-005	4.239E-004	29.37	32.25
7	2.411	61.2	2430000	2.116E-005	5.373E-004	30.57	33.57
8	2.522	64.1	2435000	2.710E-005	6.885E-004	32.33	35.49
9	2.586	65.7	2437500	3.130E-005	7.951E-004	33.41	36.69
10	2.667	67.7	2440000	3.631E-005	9.222E-004	34.93	38.35
11	2.767	70.3	2442500	4.180E-005	1.062E-003	36.99	40.61
12	2.817	71.5	2443750	4.767E-005	1.211E-003	38.10	41.83
13	2.875	73.0	2445000	5.787E-005	1.470E-003	39.49	43.36
14	2.945	74.8	2446250	7.100E-005	1.803E-003	41.31	45.36
15	3.041	77.2	2447500	9.270E-005	2.355E-003	44.09	48.42

HTS
R= 0.8
TEMP. AMBIENT
FREQUENCY 0.5 HZ
ENVIRONMENT 3.5 % NACL

7 PT. POLYNOMIAL FIT

OBS.	CRACK LENGTH		CYCLES	DA/DN PER CYCLE		DELTA K	
	IN.	MM.		IN.	MM.	KSI $\sqrt{IN.}$	MPA $\sqrt{M.}$
4	1.919	48.8	595000	7.024E-007	1.784E-005	11.52	12.65
5	1.983	50.4	675000	7.443E-007	1.891E-005	11.83	12.99
6	2.012	51.1	715000	7.579E-007	1.925E-005	11.98	13.15
7	2.068	52.5	790000	8.303E-007	2.109E-005	12.27	13.47
8	2.105	53.5	835000	9.177E-007	2.331E-005	12.47	13.69
9	2.135	54.2	870000	1.106E-006	2.809E-005	12.63	13.87
10	2.170	55.1	900000	1.233E-006	3.132E-005	12.83	14.09
11	2.209	56.1	930000	1.350E-006	3.427E-005	13.06	14.34
12	2.238	56.8	950000	1.393E-006	3.538E-005	13.23	14.52
13	2.274	57.8	975000	1.440E-006	3.657E-005	13.45	14.77
14	2.289	58.1	995000	1.533E-006	3.893E-005	13.54	14.87

HY-100
R= 0.1
TEMP. AMBIENT
FREQUENCY 5 HZ
ENVIRONMENT AIR

7 PT. POLYNOMIAL FIT

OBS.	CRACK LENGTH		CYCLES	DA/DN PER CYCLE		DELTA K	
	IN.	MM.		IN.	MM.	KSI$\sqrt{IN.}$	MPA$\sqrt{M.}$
4	2.191	55.6	274000	7.225E-006	1.835E-004	33.82	37.14
5	2.273	57.7	286000	8.752E-006	2.223E-004	35.10	38.54
6	2.353	59.8	295000	9.908E-006	2.517E-004	36.42	39.99
7	2.436	61.9	303000	1.070E-005	2.719E-004	37.92	41.64
8	2.513	63.8	310000	1.162E-005	2.950E-004	39.40	43.26
9	2.597	66.0	317000	1.277E-005	3.244E-004	41.16	45.19
10	2.660	67.6	322000	1.366E-005	3.469E-004	42.60	46.78
11	2.732	69.4	327000	1.502E-005	3.816E-004	44.35	48.70
12	2.777	70.5	330000	1.599E-005	4.061E-004	45.53	49.99
13	2.826	71.8	333000	1.710E-005	4.344E-004	46.90	51.50
14	2.878	73.1	336000	1.812E-005	4.601E-004	48.42	53.17
15	2.934	74.5	339000	1.957E-005	4.970E-004	50.19	55.10
16	2.995	76.1	342000	2.137E-005	5.427E-004	52.29	57.42
17	3.037	77.1	344000	2.327E-005	5.912E-004	53.83	59.10
18	3.085	78.4	346000	2.559E-005	6.500E-004	55.67	61.12
19	3.123	79.3	347500	2.836E-005	7.203E-004	57.25	62.86
20	3.167	80.5	349000	3.153E-005	8.008E-004	59.18	64.98
21	3.200	81.3	350000	3.307E-005	8.399E-004	60.66	66.61
22	3.234	82.1	351000	3.539E-005	8.990E-004	62.32	68.43
23	3.261	82.8	351750	3.703E-005	9.406E-004	63.70	69.94
24	3.290	83.6	352500	3.858E-005	9.799E-004	65.21	71.60
25	3.319	84.3	353250	3.945E-005	1.002E-003	66.80	73.35
26	3.338	84.8	353750	4.120E-005	1.047E-003	67.93	74.59
27	3.381	85.9	354750	4.600E-005	1.169E-003	70.50	77.41
28	3.403	86.4	355250	4.879E-005	1.239E-003	71.90	78.95
29	3.428	87.1	355750	5.262E-005	1.337E-003	73.55	80.76
30	3.456	87.8	356250	5.744E-005	1.459E-003	75.41	82.80
31	3.480	88.4	356650	6.147E-005	1.561E-003	77.14	84.70
32	3.501	89.0	357050	6.727E-005	1.707E-003	78.97	86.71
33	3.524	89.5	357350	7.069E-005	1.795E-003	80.53	88.43
34	3.547	90.1	357650	7.688E-005	1.953E-003	82.32	90.39
35	3.570	90.7	357950	8.245E-005	2.094E-003	84.30	92.56
36	3.587	91.1	358150	8.714E-005	2.213E-003	85.74	94.14
37	3.605	91.6	358350	9.077E-005	2.306E-003	87.35	95.91
38	3.623	92.0	358550	9.459E-005	2.403E-003	89.03	97.76

HY-100
R= 0.666
TEMP. AMBIENT
FREQUENCY 5 HZ
ENVIRONMENT AIR

7 PT. POLYNOMIAL FIT

OBS.	CRACK LENGTH IN.	CRACK LENGTH MM.	CYCLES	DA/DN PER CYCLE IN.	DA/DN PER CYCLE MM.	DELTA K KSI√IN.	DELTA K MPA√M
4	2.012	51.1	1560000	4.858E-007	1.234E-005	12.28	13.48
5	2.085	53.0	1704000	5.398E-007	1.371E-005	12.67	13.91
6	2.179	55.3	1876000	6.077E-007	1.543E-005	13.20	14.49
7	2.288	58.1	2043000	7.058E-007	1.793E-005	13.87	15.23
8	2.385	60.6	2180000	8.044E-007	2.043E-005	14.52	15.94
9	2.442	62.0	2252000	8.862E-007	2.251E-005	14.92	16.39
10	2.510	63.7	2324000	9.805E-007	2.491E-005	15.44	16.96
11	2.579	65.5	2396000	1.092E-006	2.773E-005	16.01	17.58
12	2.661	67.6	2468000	1.255E-006	3.187E-005	16.73	18.37
13	2.725	69.2	2518000	1.428E-006	3.627E-005	17.35	19.05
14	2.792	70.9	2563000	1.621E-006	4.118E-005	18.05	19.82
15	2.832	71.9	2587000	1.792E-006	4.551E-005	18.48	20.29
16	2.873	73.0	2610000	1.963E-006	4.986E-005	18.96	20.82
17	2.913	74.0	2630000	2.160E-006	5.487E-005	19.45	21.36
18	2.958	75.1	2650000	2.389E-006	6.068E-005	20.03	22.00
19	2.994	76.1	2665000	2.588E-006	6.572E-005	20.53	22.54
20	3.035	77.1	2680000	2.835E-006	7.201E-005	21.11	23.18
21	3.063	77.8	2690000	3.017E-006	7.663E-005	21.54	23.65
22	3.095	78.6	2700000	3.197E-006	8.117E-005	22.03	24.19
23	3.127	79.4	2710000	3.481E-006	8.842E-005	22.55	24.76
24	3.163	80.3	2720000	3.795E-006	9.640E-005	23.17	25.44
25	3.192	81.1	2727500	3.997E-006	1.015E-004	23.69	26.02
26	3.223	81.9	2735000	4.266E-006	1.084E-004	24.27	26.65
27	3.267	83.0	2745000	4.652E-006	1.182E-004	25.16	27.63
28	3.291	83.6	2750000	4.981E-006	1.265E-004	25.66	28.17
29	3.316	84.2	2755000	5.311E-006	1.349E-004	26.19	28.76
30	3.337	84.8	2759000	5.750E-006	1.460E-004	26.67	29.28
31	3.361	85.4	2763000	6.212E-006	1.578E-004	27.23	29.90
32	3.386	86.0	2767000	6.571E-006	1.669E-004	27.85	30.58
33	3.410	86.6	2770500	6.857E-006	1.742E-004	28.45	31.24
34	3.431	87.2	2773500	7.033E-006	1.786E-004	29.00	31.84
35	3.450	87.6	2776000	7.277E-006	1.848E-004	29.49	32.38
36	3.467	88.1	2778500	7.302E-006	1.855E-004	29.98	32.92
37	3.508	89.1	2784000	8.040E-006	2.042E-004	31.18	34.24
38	3.525	89.5	2786000	8.438E-006	2.143E-004	31.68	34.78
39	3.542	90.0	2788000	9.012E-006	2.289E-004	32.22	35.37
40	3.560	90.4	2790000	9.536E-006	2.422E-004	32.81	36.02

HY-100
R= 0.8
TEMP. AMBIENT
FREQUENCY 5 HZ
ENVIRONMENT AIR

7 PT. POLYNOMIAL FIT

OBS.	CRACK LENGTH		CYCLES	DA/DN PER CYCLE		DELTA K	
	IN.	MM.		IN.	MM.	KSI$\sqrt{IN.}$	MPA$\sqrt{M.}$
4	1.976	50.2	2100000	3.947E-007	1.003E-005	12.36	13.57
5	2.037	51.7	2250000	4.719E-007	1.199E-005	12.68	13.93
6	2.110	53.6	2400000	5.815E-007	1.477E-005	13.09	14.37
7	2.170	55.1	2500000	6.787E-007	1.724E-005	13.44	14.76
8	2.243	57.0	2600000	7.842E-007	1.992E-005	13.88	15.25
9	2.283	58.0	2650000	8.205E-007	2.084E-005	14.14	15.52
10	2.325	59.1	2700000	8.700E-007	2.210E-005	14.42	15.83
11	2.371	60.2	2750000	9.219E-007	2.342E-005	14.74	16.18
12	2.416	61.4	2800000	9.958E-007	2.527E-005	15.06	16.53
13	2.466	62.6	2850000	1.075E-006	2.731E-005	15.44	16.95
14	2.510	63.8	2890000	1.156E-006	2.937E-005	15.78	17.33
15	2.559	65.0	2930000	1.238E-006	3.145E-005	16.18	17.77
16	2.598	66.0	2960000	1.279E-006	3.248E-005	16.51	18.13
17	2.637	67.0	2990000	1.326E-006	3.368E-005	16.87	18.52
18	2.669	67.8	3015000	1.398E-006	3.551E-005	17.16	18.85
19	2.705	68.7	3040000	1.517E-006	3.853E-005	17.52	19.23
20	2.743	69.7	3065000	1.631E-006	4.142E-005	17.90	19.66
21	2.777	70.5	3085000	1.723E-006	4.378E-005	18.26	20.05
22	2.803	71.2	3100000	1.895E-006	4.813E-005	18.55	20.36
23	2.833	72.0	3115000	1.934E-006	4.913E-005	18.89	20.74
24	2.862	72.7	3130000	2.026E-006	5.145E-005	19.22	21.11
25	2.894	73.5	3145000	2.028E-006	5.151E-005	19.62	21.55
26	2.926	74.3	3160000	2.045E-006	5.193E-005	20.02	21.99
27	2.956	75.1	3175000	2.029E-006	5.154E-005	20.43	22.43
28	2.984	75.8	3190000	2.031E-006	5.159E-005	20.81	22.85
29	3.016	76.6	3205000	2.207E-006	5.606E-005	21.26	23.34
30	3.036	77.1	3215000	2.372E-006	6.025E-005	21.56	23.67
31	3.061	77.8	3225000	2.638E-006	6.701E-005	21.95	24.10
32	3.088	78.4	3235000	2.864E-006	7.275E-005	22.37	24.56
33	3.112	79.0	3243000	3.070E-006	7.799E-005	22.76	24.99
34	3.135	79.6	3250000	3.069E-006	7.796E-005	23.15	25.42
35	3.154	80.1	3256000	3.155E-006	8.014E-005	23.47	25.78
36	3.166	80.4	3262000	4.111E-006	1.044E-004	23.70	26.02

HY-100
R= 0.1
TEMP. AMBIENT
FREQUENCY 0.5 HZ
ENVIRONMENT 3.5 % NACL

7 PT. POLYNOMIAL FIT

OBS	CRACK LENGTH		CYCLES	DA/DN PER CYCLE		DELTA K	
	IN.	MM.		IN.	MM.	KSI$\sqrt{IN.}$	MPA$\sqrt{M.}$
4	2.135	54.2	44625	1.550E-005	3.938E-004	33.06	36.30
5	2.223	56.5	50000	1.605E-005	4.076E-004	34.38	37.75
6	2.303	58.5	55000	1.659E-005	4.215E-004	35.66	39.15
7	2.388	60.6	60000	1.744E-005	4.431E-004	37.12	40.76
8	2.475	62.9	65000	1.836E-005	4.665E-004	38.75	42.55
9	2.568	65.2	70000	1.991E-005	5.057E-004	40.63	44.62
10	2.619	66.5	72500	1.999E-005	5.078E-004	41.77	45.86
11	2.673	67.9	75000	2.032E-005	5.161E-004	43.02	47.24
12	2.762	70.2	79310	2.034E-005	5.167E-004	45.26	49.70
13	2.825	71.8	82500	2.089E-005	5.307E-004	47.01	51.61
14	2.876	73.1	85000	2.220E-005	5.638E-004	48.52	53.28
15	2.928	74.4	87500	2.352E-005	5.973E-004	50.18	55.09
16	2.990	76.0	90000	2.574E-005	6.539E-004	52.29	57.41
17	3.044	77.3	92000	2.708E-005	6.878E-004	54.28	59.60
18	3.086	78.4	93500	2.797E-005	7.105E-004	55.92	61.40
19	3.129	79.5	95000	2.939E-005	7.464E-004	57.69	63.34
20	3.165	80.4	96250	3.081E-005	7.825E-004	59.27	65.08
21	3.205	81.4	97500	3.220E-005	8.178E-004	61.14	67.13
22	3.236	82.2	98500	3.557E-005	9.036E-004	62.65	68.79
23	3.272	83.1	99500	3.932E-005	9.986E-004	64.51	70.84
24	3.312	84.1	100500	4.372E-005	1.111E-003	66.70	73.24
25	3.357	85.3	101500	5.034E-005	1.279E-003	69.32	76.12
26	3.397	86.3	102250	5.598E-005	1.422E-003	71.80	78.83
27	3.427	87.0	102750	5.953E-005	1.512E-003	73.78	81.01
28	3.455	87.8	103250	6.496E-005	1.650E-003	75.77	83.20
29	3.479	88.4	103600	6.982E-005	1.773E-003	77.48	85.07
30	3.501	88.9	103900	7.450E-005	1.892E-003	79.10	86.85
31	[illegible]523	89.5	104200	7.918E-005	2.011E-003	80.84	88.76
32	3.543	90.0	104450	8.646E-005	2.196E-003	82.47	90.55
33	3.561	90.4	104650	9.254E-005	2.351E-003	83.93	92.15
34	3.580	90.9	104850	9.964E-005	2.531E-003	85.56	93.95

HY-100
R= 0.666
TEMP. AMBIENT
FREQUENCY 0.5 HZ
ENVIRONMENT 3.5 % NACL

7 PT. POLYNOMIAL FIT

(1ST 3 PTS. FIT BY SECANT METHOD)

OBS.	CRACK LENGTH		CYCLES	DA/DN PER CYCLE		DELTA K	
	IN.	MM.		IN.	MM.	KSI $\sqrt{IN.}$	MPA $\sqrt{M.}$
2	1.822	46.3	195000	1.949E-006	4.951E-005	11.37	12.48
3	1.916	48.7	230000	2.343E-006	5.951E-005	11.82	12.98
4	2.042	51.9	265000	2.490E-006	6.325E-005	12.47	13.70
5	2.119	53.8	295000	2.777E-006	7.053E-005	12.90	14.16
6	2.218	56.3	330000	3.278E-006	8.327E-005	13.47	14.80
7	2.301	58.4	355000	3.741E-006	9.503E-005	13.99	15.37
8	2.337	59.3	365000	4.028E-006	1.023E-004	14.23	15.62
9	2.424	61.6	385000	4.436E-006	1.127E-004	14.84	16.29
10	2.496	63.4	400000	4.829E-006	1.226E-004	15.38	16.88
11	2.540	64.5	410000	5.069E-006	1.287E-004	15.73	17.28
12	2.619	66.5	425000	5.860E-006	1.488E-004	16.40	18.01
13	2.679	68.0	435000	6.588E-006	1.673E-004	16.95	18.61
14	2.745	69.7	445000	7.558E-006	1.920E-004	17.60	19.33
15	2.826	71.8	455000	8.714E-006	2.213E-004	18.47	20.29
16	2.869	72.9	460000	9.545E-006	2.424E-004	18.98	20.84
17	2.919	74.2	465000	1.028E-005	2.610E-004	19.59	21.51
18	2.972	75.5	470000	1.133E-005	2.877E-004	20.29	22.28
19	3.000	76.2	472500	1.211E-005	3.075E-004	20.67	22.70
20	3.063	77.8	477500	1.350E-005	3.430E-004	21.60	23.72
21	3.098	78.7	480000	1.416E-005	3.598E-004	22.15	24.32
22	3.134	79.6	482500	1.420E-005	3.608E-004	22.75	24.98
23	3.165	80.4	484500	1.481E-005	3.761E-004	23.28	25.57
24	3.192	81.1	486500	1.569E-005	3.985E-004	23.78	26.11
25	3.224	81.9	488500	1.591E-005	4.042E-004	24.38	26.77
26	3.257	82.7	490500	1.746E-005	4.435E-004	25.03	27.48
27	3.293	83.7	492500	1.823E-005	4.630E-004	25.80	28.33
28	3.332	84.6	494500	1.949E-005	4.952E-004	26.66	29.27
29	3.351	85.1	495500	1.999E-005	5.077E-004	27.09	29.74
30	3.391	86.1	497500	2.184E-005	5.547E-004	28.05	30.80

HY-100
R= 0.8
TEMP. AMBIENT
FREQUENCY 0.5 HZ
ENVIRONMENT 3.5 % NACL

7 PT. POLYNOMIAL FIT

(1ST 3 PTS. FIT BY SECANT METHOD)

OBS.	CRACK LENGTH		CYCLES	DA/DN PER CYCLE		DELTA K	
	IN.	MM.		IN.	MM.	KSI$\sqrt{IN.}$	MPA$\sqrt{M.}$
2	1.799	45.7	225000	1.567E-006	3.981E-005	11.50	12.63
3	1.863	47.3	265000	1.627E-006	4.132E-005	11.81	12.97
4	2.026	51.5	350000	2.578E-006	6.548E-005	12.65	13.89
5	2.520	64.0	490000	4.990E-006	1.267E-004	15.90	17.46